

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

Wetland Enhancement

(Acre)

Code 659

DEFINITION

The modification or rehabilitation of an existing or degraded wetland, where specific functions and /or values are modified for the purpose of meeting specific project objectives. Some functions may remain unchanged while others may be degraded.

PURPOSES

To modify the hydrologic condition, hydrophytic plant communities, and/or other biological habitat components of a wetland for the purpose of favoring specific wetland functions or values.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on any degraded or existing wetland where the objective is to specifically enhance a selected wetland function(s) and/or value(s).

Enhancement shall not significantly change the primary wetland functions provided at the site.

Upon completion of the enhancement the site will meet the current NRCS soil, hydrology, and vegetation criteria of a wetland.

Where hydrology enhancement is involved, this practice is applicable only if modifying drainage and/or artificial flooding can achieve project objectives.

Sites containing hazardous materials will not be enhanced under this standard. If the presence of

hazardous materials in the sediment or fill is suspected, soil samples will be collected and analyzed for the presence of hazardous materials as defined by local, state, or federal regulations.

This practice does **not** apply to:

- Constructed Wetland (656) intended to treat point and non-point sources of pollution.
- Wetland Restoration (657) intended to rehabilitate a degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to original conditions.
- Wetland Creation (658) for creating a wetland on a site location that historically was not a wetland, and
- Where unique wetlands such as, but not limited to, calcareous fens, bogs, coastal lake plain prairies or acid seeps exist.

CRITERIA

The landowner shall obtain necessary local, state, and federal permits that apply prior to enhancement.

Enhanced Wetlands shall be planned, designed, and constructed to comply with all Federal, State, and local laws and regulations.

The soil, hydrology and vegetative characteristics existing on the site and the

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

contributing watershed shall be documented before enhancement of the site begins.

The effect of any modification to the existing surface and/or subsurface drainage system on upstream, adjacent, and downstream landowners will be evaluated in the design. Upstream surface and subsurface drainage will not be impacted unless appropriate written permissions are obtained.

Excessive sediment, nutrient, pesticide, or other pollutant inflows will be controlled prior to site enhancement.

Sites containing threatened or endangered species will not be enhanced under this standard unless it can be demonstrated that the practice will not negatively impact the species at risk.

Hydric Soil Criteria

Enhancement sites will be located on hydric soils. If the hydric soil is covered by fill or sediment, the site must be capable of meeting hydric soil criteria or the fill and sediment must be removed to the surface of the original hydric soil.

Hydrology Criteria

No more than 25% of the total surface area shall exceed 3 feet in depth.

Refer to the Engineering Field Handbook, Chapter 13, "Wetland Restoration, Enhancement, and Creation," and Chapter 6, "Structures," for additional design information.

Existing drainage systems will be utilized, removed, or modified as needed to achieve the intended purpose.

Wetland hydrology shall be enhanced using one or any combination of the following:

1. Excavation

Where an area containing hydric soil has been covered by fill or sediment, the wetland hydrology may be enhanced by excavating.

Excavated areas may also be constructed to provide a source of fill materials for

embankments or ditch plugs within the same wetland area. In this case, excavation may occur below the original hydric soil surface.

All newly excavated spoil not used in the embankment, ditch plug construction or macrotopography development shall be removed from the wetlands.

Excavated wetlands shall have the following characteristics:

- Side slopes of 6:1 or flatter
- Minimum size of 0.1 acre

2. Subsurface Drain Removal or Destruction

Performing one or more of the following may eliminate the effects of a subsurface drainage system:

- Removing or rendering inoperable a portion of the drain,
- Modifying the drain with a water control device, or
- Installing non-perforated pipe through the wetland site.

The minimum length of drain to be removed or rendered inoperable is shown in Table 1.

If present, all sand and gravel bedding and filtering material or other flow enhancing material will also be removed. The trench will be filled or compacted to achieve a density equal that of adjacent material.

Where embankments will be constructed, all subsurface drains shall be removed starting at one-half the minimum distance, shown on Table 1, downstream of the embankment centerline.

Installation of non-perforated subsurface drain around or through the wetland may be necessary to allow upstream drainage systems to continue to function properly.

3. Surface Drain Filling

Where open channels and shallow surface drains provide surface and subsurface drainage, and a compacted embankment will not be used, the channel or surface drain will be:

- Totally filled with earth, or
- Filled with a single ditch plug or series of ditch plugs to the full depth of the ditch and according to Table 1, or
- Filled with a ditch plug to a height less than the full depth of the ditch and according to Table 1, and have an outlet designed according to Grade Stabilization Structure (410) or Structure for Water Control (587).

Table 1. Minimum Length*of Drain to be Plugged, Removed or Rendered Inoperable.

Soil Texture ^{1/}	Minimum Length (feet)
Sandy or Organic	150
Loamy	100
Clayey	50

*The length is measured parallel to the direction of the surface drain flow along the top of the settled ditch plug.

^{1/} USDA Soil Texture.

4. Embankments

Embankments shall be constructed of compacted earth fill according to this standard.

Class of dam shall be determined. If not class "a", refer to pond (378) for embankment design.

Site Preparation. Vegetation, topsoil and debris shall be removed from under the embankment.

Cutoff Trench. Include a cutoff trench for all embankments with a fill height greater than 4 feet and if necessary for seepage control on embankments less than or equal to 4 feet in height.

Settlement. A minimum 5% of additional fill shall be added to the design height to prevent settling of the embankment below the design elevation.

Fill Height. The fill height shall be less than 20 feet.

Top Width. The minimum top width shall be according to Table 2. Top width shall be increased to a minimum of 15 feet for organic soils.

Table 2. Minimum Top Width

Fill Height (feet)	Minimum Top Width (feet)
<10	6
10 to <15	8
15 to <20	10

Side Slopes. Front slopes on embankments must be 4:1 or flatter and back slopes must be 3:1 or flatter.

Organic soils. Organic soils shall not be used for embankments exceeding 5 feet in structural height.

Seeding. Embankments will be seeded according to Table 3.

Table 3. Seeding mixes for embankments.

Species	PLS Rates/AC
^{1,2} Orchardgrass	6
Timothy	2
Annual Lespedeza	4
Ladino Clover	¼
¹ Redtop	2
Orchardgrass	6
Annual Lespedeza	4
Ladino Clover	¼
¹ Redtop	2
Timothy	2
Red Clover	2
Annual Lespedeza	4
Orchardgrass	6
Timothy	2
Alfalfa	6
Ladino Clover	¼
³ Smooth Brome	10
Alfalfa	6
Ladino Clover	¼
Birdsfoot Trefoil	4
⁴ Timothy	2
Smooth Bromegrass	10
Alsike Clover	1
Birdsfoot Trefoil	4
¹ Timothy	2
Ky. Bluegrass	3
Annual Lespedeza	4
Birdsfoot Trefoil	4
Switchgrass	8

Species	PLS Rates/AC
⁴ Redtop	2
Timothy	2
Alsike Clover	2
Birdsfoot Trefoil	4
¹ Redtop	2
Ky. Bluegrass	3
Annual Lespedeza	4
Ladino Clover	¼
¹ Orchardgrass	6
Timothy	2
Red Clover	2
Ladino Clover	¼
Annual Lespedeza	4
³ Smooth Bromegrass	10
Timothy	2
Ladino Clover	¼
Birdsfoot Trefoil	4
¹ Orchardgrass	6
Timothy	2
Red Clover	2
Sweet Clover	3
¹ Timothy	2
Ky. Bluegrass	3
Annual Lespedeza	4
Red Clover	2
Orchard grass	6
Timothy	2
Ladino Clover	¼
Birdsfoot Trefoil	4

¹ Better suited for the Southern part of Indiana² Can be used on droughty sites³ Better suited for the Northern part of Indiana⁴ Can be used on wet sites

Note: 2 to 8 oz of any single or combination of the forb species listed below can be added to any of the above mixtures for added wildlife and aesthetic benefits or substituted for one of the legumes in the mix.

Forb Species

Blackeyed Susan	Illinois Bundle Flower	Stiff Goldenrod
Butterflyweed	New England Aster	Sunflower Heliopsis
Button Blazing Star	Partridge Pea	Tall Coreopsis
Dense Blazing Star	Prairie Dock	Virginia Mountain Mint
Entire-Leaf Rosinwood	Purple Coneflower	Wild Bergamot
Gray-Headed Coneflower	Sawtooth Sunflower	

Spillways

A stable spillway is required for all embankment wetlands.

Principal and emergency spillways shall be designed to handle the capacities listed in Table 4. The capacities can be met with flow through spillways and/or temporary storage.

Table 4. Minimum Capacity for Principal and Emergency Spillway ^{1/} (24-hour storm).

Drainage Area (acres)	Principal Spillway	Emergency Spillway
<10	^{2/}	Q ₁₀
10 to <20	Q ₂	Q ₁₀
20 or more	Q ₅	Q ₂₅

^{1/} Where storage exceeds 50 ac-ft refer to pond (378) for principle and emergency spillway design capacities.

^{2/} Where the wetland is spring fed or has other sources of base flow, a pipe shall be installed with a capacity at least equal to the maximum spring or base flow.

Antiseep collars or filter and drainage diaphragms shall be installed around the pipe conduit if any of the following conditions exist:

- The conduit is of smooth pipe larger than 8 inches in diameter.

Table 5. Vegetative mixes for spillways.

Mix	Species	PLS Rates/AC
1	Timothy	5
	Redtop	2
	Alsike	1
	Ladino	¼
2	Low endophyte Fescue	35
	Alsike	1
	Ladino	¼

Add a bushel of oats or a half-bushel of wheat to any of these mixes if a quick cover or nurse crop is needed.

- The conduit is of corrugated metal pipe larger than 12 inches in diameter.
- The head from the crest of the spillway to the flow line of the outlet channel exceeds 5 feet.

If the pipe is connected to a subsurface drain, the drain shall be non-perforated downstream from the embankment centerline for one half the minimum distance shown in Table 1.

The inlet invert of a pipe shall be a minimum of 1.0 foot below the crest of any vegetated spillway.

Where wetland water level manipulation is desired, other structural details shall meet the requirements of Structure for Water Control (587), as applicable.

Pipe components shall meet material requirements of Underground Outlet (620), Subsurface Drain (606), or Pond (378).

The emergency spillway shall have a minimum freeboard of 1 foot above the design flow elevation (Hp).

Spillways will be seeded according to Table 5.

Vegetative Criteria

In normal situations, rely on existing seed banks in the soil and seed colonization from nearby wetlands to revegetate the wetland.

When regeneration of vegetation is unlikely to occur within 3 years, a planting plan will be developed.

If there are special circumstances that would require planting the wetland, the vegetation selected should be compatible with the planned hydrologic condition. Examples of special circumstances would include enhancing an isolated wetland that has been in crop production for many years or where there is a high probability that non-native or aggressive plant species will invade an enhancement site.

Plantings, seeding, or other types of vegetative establishment will be comprised of native species that occur on the wetland type being restored. Refer to tables 6 and 7 for shrub and tree species.

Where planting of herbaceous vegetation is necessary, only local genotypes of native species will be utilized when practicable.

Functions Criteria

Wetland goals and objectives shall include targeted wetland functions for the enhanced wetland.

Project goals and objectives shall minimize adverse impacts to wetland functions not specifically targeted for enhancement.

Table 6. Shrub List

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
Alternate Leaf Dogwood <i>Cornus alternifolia</i>	SPD – WD	18	Fruit eaten by birds. Twigs browsed by deer and rabbits.	Blue-black fruit with red stems. Leaves not opposite.
Black Chokeberry <i>Aronia melanocarpa</i>	SPD – WD	10	Fruit eaten by songbirds.	Fruit 1/3" long, dark- purple.
Bladdernut <i>Staphylea trifolia</i>	SPD – WD	10		3 lobed balloon like capsule.
Buttonbush <i>Cephalanthus occidentalis</i>	VPD – SPD	5	Seeds consumed by many bird species.	Nutlets, best on wet sites. Wilted leaves may be toxic to livestock.
Devils Walking Stick <i>Aralia spinosa</i>	SPD - MWD	20	Fruit eaten by birds.	Stout stem with spines, showy white flowers that produce a black drupe.

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
Eastern Wahoo <i>Euonymus atropurpureus</i>	SPD – WD	12	Fruit eaten by birds.	4 lobed red capsules, sometimes winged stem.
Elderberry <i>Sambucus canadensis</i>	VPD – WD	9	Fruit eaten by many birds including pheasant, dove and turkey. Plant contains hydrocyanic acid. Recommended for quail.	Purple-black drupe used for jams, jellies, pies, and wine.
Gray Dogwood <i>Cornus racemosa</i>	SPD – WD	8	Fruit eaten by pheasant and grouse.	Red pedicles in winter, white drupe.
Hazel Alder <i>Alnus serrulata</i>	VPD – WD	18	Deer browse on the twigs.	Prefers wet to moist soils. Long lenticles on the stem.
Highbush Cranberry <i>Viburnum trilobum</i>	VPD – WD	9	Fruit eaten by grouse, pheasant and songbirds.	Tart red fruits. Showy.
Indigobush <i>Amorpha fruticosa</i>	VPD – WD	6		Small pods, flowers purplish spikes.
Nannyberry <i>Viburnum lentago</i>	SPD – WD	18	Fruit eaten by songbirds.	Blue-black fruits similar to raisins.
Ninebark <i>Physocarpus opulifolius</i>	VPD – WD	10	Fruit are small dry bladders lasting through winter.	White to pinkish flowers.
Pawpaw <i>Asimina triloba</i>	SPD – WD	20	Fruit eaten by opossum, squirrels, raccoon and fox.	Large leaves, likes deep moist soils.
Prairie Crab <i>Malus ioensis</i>	PD – WD	30	Fruit eaten by opossum, squirrels, raccoon and fox.	Small fruit, showy flowers.
Prickly Ash <i>Xanthoxylum americanum</i>	SPD – WD	9		A thicket-forming shrub with prickly leafstalks. Fruits are a small reddish-brown pod. Chewing plant parts was once a popular toothache cure.
Red Osier Dogwood <i>Cornus stolonifera</i>	VPD – WD	10	Fruit eaten by songbirds, grouse, and quail. Twigs browsed by deer, rabbits.	Reddish stem, white drupe, good winter color.
Rough Leaved Dogwood <i>Cornus drummondii</i>	PD – WD	18	Fruit eaten by songbirds, grouse, quail, turkey and pheasant. Browsed some by rabbits and deer.	White drupes.
Shrubby St. Johnswort <i>Hypericum prolificum</i>	SPD – WD	6		Bright yellow flowers, 3-valved capsule.
Silky Dogwood <i>Cornus amomum</i>	VPD – WD	10	Sometimes browsed by rabbits and deer.	Bluish fruit, likes moist soils and partial shade.

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
Spicebush <i>Lindera benzoin</i>	VPD – WD	9	Twigs and fruit eaten by songbirds, deer, rabbit, opossum, quail and grouse.	Small red drupe.
Spirea <i>Spiraea alba</i> <i>Spiraea tomentosa</i>	VPD – WD	4	Spirea buds eaten by ruffed grouse and twigs browsed by deer and rabbits.	Pink flowers. Also called Meadowsweet or Hardack.
Wild Sweet Crabapple <i>Malus coronaria</i>	SPD – ED	30	Recommended for quail.	Yellow-green edible fruit with highly fragrant flowers.
Winterberry <i>Ilex verticillata</i>	VPD – SPD	10	Red fruits used as an emergency food source for wildlife.	Erect shrub with small greenish white flowers and bright red berries that persist through winter. Must have male and female plants for pollination.
Witch-hazel <i>Hamamelis virginiana</i>	SPD – WD	18	Seeds, buds and twigs eaten by deer, rabbit, quail and pheasant.	Pale yellow flowers that produce pods with seeds.

* **KEY:** ED = Excessively Drained

WD = Well Drained

MWD = Moderately Well Drained

SPD = Somewhat Poorly Drained

PD = Poorly Drained

VPD = Very Poorly Drained

Table 7. Tree List

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
American Hornbeam <i>Carpinus caroliniana</i>	SPD - ED	20	Seeds and catkins consumed by songbirds and squirrels.	Shrub or small tree in the birch family. Also called muscle wood due to the smooth gray, striated bark. Common in floodplains.
American Sycamore <i>Platanus occidentalis</i>	PD - WD	90	Sycamore does not have much food value to wildlife; however, this species forms an important structural component of bottomlands and floodplains.	The sycamore is one of our largest trees capable of obtaining heights of over 100 feet. Attractive multicolored bark.

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
Ash, Green <i>Fraxinus pennsylvanica</i>	VPD - WD	60	Seeds eaten by squirrels, quail, and songbirds.	Medium sized tree, which is a common component of swamps and floodplains.
Baldcypress <i>Taxodium distichum</i>	VPD - WD	80	Waterfowl occasionally consume seeds. Trees also serve as perching areas for song and wading birds.	The baldcypress is one of two deciduous conifer trees native to Indiana. Perhaps the most flood tolerant of our trees. Often forms an attractive elliptical crown.
Beech, American <i>Fagus grandifolia</i>	SPD- WD	75	Nuts consumed by turkeys, deer, and squirrels.	Extremely shade tolerant species with decorative smooth gray bark.
Birch, River <i>Betula nigra</i>	VPD - WD	50	Stands of birch serve as important cover for riparian dwelling animals.	Small to medium sized tree of floodplains. Attractive cinnamon colored, exfoliating bark.
Black Gum <i>Nyssa sylvatica</i>	PD – WD	60	Fruits consumed by songbirds, turkeys and pileated woodpeckers.	Medium sized tree, which thrives in both upland and wetland conditions. Foliage turns an attractive red color in fall.
Buckeye, Ohio <i>Aesculus glabra</i>	SPD- WD	60	Nuts sparingly consumed by eastern fox squirrels.	Fast growing species. Twigs poisonous to livestock.
Catalpa <i>Catalpa speciosa</i>	PD – WD	50	Trees provide cover for a variety of wildlife.	Medium sized tree with large heart shaped leaves and cigar like fruits.
Cedar, Eastern Red <i>Juniperus virginiana</i>	SPD- ED	45	Berries consumed by songbirds.	Small coniferous tree tolerant of dry, sterile soils.
Cottonwood, Eastern <i>Populus deltoides</i>	ED – PD	90	Twigs and bark consumed by deer and beavers. Buds and catkins eaten by ruffed grouse.	Large tree typical of riverbanks. The triangles shaped (deltoid) leaves, which flutter in breeze, give this tree its specific name.
Hackberry <i>Celtis occidentalis</i>	SPD – WD	50	Fruits are sparingly consumed by songbirds, including cedar waxwings, mockingbirds, and robins, throughout winter.	Small to medium sized tree of calcareous soils and floodplains. The taste of the fruits may be likened to dates, but contain a large seed.
Hawthorn, Cockspur <i>Crataegus crus-galli</i>	ED – SPD	30	Fruits make up an important winter food source for many species of songbirds including ruffed grouse. Fruit eaten by deer, fox, rabbit, grouse and pheasant. Excellent nesting habitat for songbirds.	Large shrubs or small trees that usually bare stout spines. Attractive white flowers yield small, apple like fruits. Common in disturbed woodlands that had previously been pasture.

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
Hawthorn, Washington <i>Crataegus phaenopyrum</i>	ED – SPD	30	(see above)	(see above)
Hawthorn, Green <i>Crataegus viridis</i>	ED – SPD	30		
Hickory, Bitternut <i>Carya cordiformis</i>	SPD – WD	50	The nuts of these species constitute an important food source for squirrels. Wood ducks and wild turkeys also consume a significant quantity of these nuts.	Medium sized tree of moist woodlands. Winter buds are sulfur-yellow. The common name is derived from the bitter taste of the nut.
Hickory, Shellbark <i>Carya laciniosa</i>	VPD – WD	70		Much like shagbark hickory, but more frequent in poorly drained soils.
Kentucky Coffeetree <i>Gymnocladus dioica</i>	SPD – WD	50	Fruits relished by squirrels, opossum, raccoon and songbirds.	Uncommon, medium sized tree with gray, scaly bark. Fruit a thick, brown pod.
Maple, Black <i>Acer nigrum</i>	MWD – WD	70	Samaras are widely consumed by birds and squirrels. Browsed by deer.	Medium sized tree very similar to sugar maple, but usually found in moister soil conditions. The leaves tend to be mostly 3-lobed.
Maple, Red <i>Acer rubrum</i>	VPD – WD	70		Characteristic medium sized tree of swampy areas, but also found in upland conditions. Leaves turn an attractive scarlet red in fall.
Maple, Silver <i>Acer saccharinum</i>	VPD – WD	80		Exceptionally fast growing medium sized tree of floodplains and poorly drained soils. Small yellow (female) and reddish (male) flowers appear very early in the spring.
Mulberry, Red <i>Morus rubra</i>	SPD- WD	40	Purplish fruits preferred food source of birds and small mammals.	Small tree. Fruits edible and used in jellies, jam, and pies.
Northern White-Cedar <i>Thuja occidentalis</i>	PD – WD	40	Foliage often browsed by deer in late winter as an emergency food source.	This medium sized evergreen was once common in northern Indiana bogs. Attains best form on calcareous soils. Commonly planted ornamental.

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
Oak, Bur <i>Quercus macrocarpa</i>	PD – ED	80	The smaller pin oak acorns are particularly favored by wood ducks.	Medium to large sized tree, which grows most typically in mesic woodlands and along floodplains, but is also very drought and fire tolerant. Large acorns with fringed caps.
Oak, Cherrybark <i>Quercus pagoda</i>	SPD – WD	75		Large tree of bottomlands and well-drained soils. In Indiana, found only in the extreme southwestern part of the state.
Oak, Pin <i>Quercus palustris</i>	VPD – WD	75		Common medium sized oak of poorly drained soils and floodplains. Dead branches are seldom shed from the trunk of this species giving it a characteristic appearance.
Oak, Shingle <i>Quercus imbricaria</i>	SPD – WD	50		Small to medium sized tree of mesic woodlands. Leaves remain on tree through winter, but unlike other oaks, the leaves of this species are unlobed.
Oak, Shumard <i>Quercus shumardii</i>	SPD – WD	75		Large sized tree of well-drained soils and bottomlands. Closely resembles red oak, but usually occurs in a lower position on the landscape.
Oak, Swamp Chestnut <i>Quercus michauxii</i>	SPD – WD	70		Medium to large sized tree of poorly drained soils. Bark may be confused with that of white oak, but the coarsely serrate margined leaves distinguish this species.
Oak, Swamp White <i>Quercus bicolor</i>	VPD – WD	70		Medium sized tree of poorly drained soils. The specific name, bicolor, refers to the two toned leaves which are dark and shiny above, and dull and white below.
Pecan <i>Carya illinoensis</i>	SPD- WD	120	Ellipsoid nuts readily consumed by a variety of wildlife.	Large tree with sweet edible nuts.
Persimmon <i>Diospyros virginiana</i>	SPD – WD	50	Large berries are readily consumed by raccoons as well as some songbirds.	Small tree found in bottomlands and old fields. Fruit, a large berry, is edible when ripe.

Common Name <i>Scientific Name</i>	*Soil Moisture Tolerance	Average Mature Height (ft.)	Wildlife Information	General Comments
Sweetgum <i>Liquidambar styraciflua</i>	PD – WD	85	Seeds consumed by “northern” finches in winter.	Large tree common in bottomlands of southern Indiana. Leaves are palmately five-lobed. Fruit is a prickly ball with multiple capsules.
Tamarack <i>Larix laricina</i>	VPD – SPD	60	Seeds consumed by “northern” finches in winter.	Small to medium sized tree found in northern Indiana bogs and swamps. The only deciduous member of the pine family found in Indiana. Small cones grow upright along twigs.

* **KEY:** ED = Excessively Drained
WD = Well Drained
MWD = Moderately Well Drained

SPD = Somewhat Poorly Drained
PD = Poorly Drained
VPD = Very Poorly Drained

CONSIDERATIONS

Consider effect of volumes and rates of runoff, infiltration, evaporation, and transpiration on the water budget.

Consider as a high priority those sites adjacent to existing wetlands as they increase wetland system complexity and diversity, decrease habitat fragmentation, and ensure colonization of the site by wetland flora and fauna.

Consider linking wetlands by corridors wherever appropriate to enhance the wetland's use and colonization by the flora and fauna.

Hydrologic conditions including duration, depth, and timing are primary factors in vegetation reestablishment. In some cases, vegetation after enhancement can be predicted from historic records or existing vegetation on similar soils on nearby sites.

Consider establishing vegetative buffers on surrounding uplands to filter runoff and provide wildlife habitat, refer to Upland Wildlife Habitat Management (645) or Filter Strip (393).

Where topography has been altered through sedimentation, filling, or leveling, consider excavating, through mechanical means, shallow depressions.

Wetlands should have an irregular shape adapted to the site.

Consider preserving native hydrophytic plant seed banks for re-vegetation.

Where burrowing animals may be a problem, consider control methods and increasing top width of embankment a minimum of 5 feet or increasing front slope to 6:1 or flatter.

If nutrient loading is a concern, consider out-letting upstream drains at the upper end of the wetland to increase nutrient assimilation.

When a planting plan is to be developed, consider consulting with a professional biologist or person knowledgeable in wetland ecosystems and plant establishment.

Preference should be given to native wetland plants with localized genetic material. Plant

materials collected or grown from material collected within a 200-mile radius from the site is considered local.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for each site. Specifications shall be recorded using approved specifications sheets, job sheets, and narrative statements in the conservation plan or other documentation.

Planting plans for herbaceous plants, shrubs and trees will include, as a minimum: species, density and planting techniques.

OPERATION AND MAINTENANCE

The following actions shall be carried out to insure that this practice functions as intended throughout its expected life. These actions include normal repetitive activities in the application and use of the practice (operation), and repair and upkeep of the practice (maintenance).

The use of fertilizers, mechanical treatments, prescribed burning, pesticides or other chemicals to assure the wetland restoration function shall not compromise the intended purpose.

Include management needed to maintain vegetation, including the control of unwanted vegetation.

The timing and level setting of water control structures required for the establishment of desired hydrologic conditions or for management of vegetation shall be included.

An inspection schedule for embankments and structures for damage assessment shall be included.

Identify the acceptable amount of sediment accumulation to be allowed before removal is required.

Haying and livestock grazing is not a compatible use.

REFERENCES

- Deam, Charles C. 1932. *Shrubs of Indiana*, 2nd edition. State of Indiana Department of Conservation, Indianapolis, IN.
- Deam, Charles C. 1953. *Trees of Indiana* 3rd edition, reprinted 1995. State of Indiana Department of Conservation, Indianapolis, IN.
- Payne, Neil F. 1992. *Techniques for Wildlife Habitat Management of Wetlands*. McGraw-Hill, Inc. 549pp.
- Kusler M. and Kentula, eds. 1990. *Wetland Creation and Restoration: The Status of the Science*. Island Press. 616pp.
- Midwestern Wetland Flora: Field Office Guide to Plant Species*. U.S.D.A. Soil Conservation Service, Midwest National Technical Center, Lincoln, Nebraska. No date.
- Harlow, William M., E.S. Harrar, J.W. Hardin, and F.M. White. 1991. *Textbook of Dendrology: covering the important forest trees of the United States and Canada*, 7th ed., McGraw-Hill, New York.
- Martin, A.C., H.S. Zim, and A.L. Nelson. 1951. *American Wildlife and Plants: A Guide to Wildlife Food Habits*, Dover, New York.
- Peattie, D.C. 1948. *A Natural History of Trees: of Eastern and Central North America*, 2nd ed., Bonanza, New York.
- U.S. Department of Agriculture Natural Resources Conservation Service, Engineering Field handbook, Chapter 6, *Structures*, 1989.
- U.S. Department of Agriculture Natural Resources Conservation Service, Engineering Field handbook, Chapter 13, *Wetland Restoration, Enhancement, or Creation*, 1992.

